Rocky Mountain Field Institute

Enhancing Resiliency in Critical Riparian Areas through Continuation of Willow Propagation Program – Final Report

Grant Number: POGG1 PDAA 201800000718

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Dedicated to the conservation and stewardship of public lands in Southern Colorado

Description of Project

This project is the continuation of a willow propagation program first started in 2016. Utilizing support from the Colorado Water Conservation Board (CWCB), RMFI increased the number of willows propagated in 2018 to 4,150 from 2,850 in 2017, and expanded planting locations to more diverse sites outside of the Waldo Canyon Fire burn scar. In addition to the willow plantings, RMFI completed critical stabilization projects within the Bear Creek Watershed to both compliment willow plantings and contribute to the ongoing watershed/stream restoration efforts to help protect the aquatic habitat of the threatened greenback cutthroat trout, Colorado's state fish. This final report is an update on the willow propagation program, and includes data from 2019 monitoring visits.

The objectives of the program are as follows:

1. Facilitate resiliency and function in 5* high priority riparian areas within the Pike National Forest through on-site willow cuttings, nursery propagation, and transplanting.
2. Continue streambank stabilization and erosion control treatments to complement willow plantings and ongoing work in the Bear Creek Watershed to protect the aquatic habitat of the threatened greenback cutthroat trout.
3. Share project outcomes and results with relevant stakeholders through a final report and meeting/conference presentations.

In order to achieve the above objectives, the project has been divided into 6 tasks, outlined below.

Task 1 - ***COMPLETE*** *(January 23- February 28, 2018):* **Prioritize and ground truth selected planting locations and riparian areas through site visits and meetings with project partners.**

*The proposal for this project included 5 potential planting locations for the willow propagation program in 2018. Unlike the planting locations identified and utilized in 2016 and 2017, these locations all fall outside of the Waldo Canyon Fire burn scar. In early 2018, site visits were conducted to each area to ground-truth locations to determine exact planting locations, logistics, and other pertinent information. However, the Pike and San Isabel National Forests suffered from an extremely dry spring with little snowpack runoff. To increase the likelihood of willow survival rates, one site included in the grant proposal was modified and a second was added. Planting locations for 2018 included: Halfmoon Creek, Poncha Creek, Molly Gulch, Bear Creek, and Severy Creek Wetland. In addition, RMFI revisited planting locations from 2016 and 2017 – Camp Creek and Waldo Canyon.

Task 2 - ***COMPLETE*** *(January 23- February 28, 2018):* **Harvest dormant willow cuttings from select locations and transport to nursery for propagation and preparation for spring transplanting.**

On January 30, 2018, RMFI and USFS staff harvested dormant willow cuttings along the Pikes Peak Highway north and south of the Crow Gulch Picnic Area (Figure 1). Approximately 1,000 cuttings measuring approximately 3-feet long were harvested. Species included narrowleaf willow (*Salix exigua*), scouler willow (*Salix scouleriana*), bebb willow (*Salix bebbiana*), and Rocky Mountain willow (*Salix monticola* Bebb). Willows were tied together in bundles and prepped for overnight shipping to the Charles E. Bessey Nursery located in Halsey, Nebraska. The willows arrived at the nursery the next day where they were cut from 3-foot segments to approximately 1-foot segments and placed in potting containers (Figure 2). In March of 2018, the willows were transplanted into individual pots to continue growth and root maturation. The willows were tended to by Richard Gilbert, Bessey Nursery Manager for the USFS.

Figure 1 (above): Willow stakes harvested on Pikes Peak in late January, 2018.

Figure 2: Willows cut to 1-foot segments and planted in containers at the Bessey Nursery in Halsey, Nebraska (left). Willows transplanted into individual pots to continue growth and root maturation (right).

*Task 3 - **COMPLETE** (May 15 - June 16, 2018):* **Transplant rooted nursery plants back on-site in selected critical riparian areas.**

A total of 4,150 willows were planted on the Pike and San Isabel National Forests in 2018. That year, the Pike and San Isabel National Forests suffered from an extremely dry spring with little snowpack runoff. To increase the likelihood of willow survival rates, a few of the sites identified in the initial grant proposal were modified. Additionally, Fourmile Creek is part of a larger Forest Service NEPA project – Sheep Mountain Environmental Assessment. The NEPA was not completed in time for 2018 willow planting so that location was omitted.

- 600 willows were planted along Halfmoon Creek where recreation sites had encroached stream banks and badly impaired existing vegetation. The USFS planted the willows.

- 1,015 willows were planted in several locations along Poncha Creek. These sites were similarly disturbed to those of Halfmoon. The USFS planted the willows.

- 360 willows were planted in Molly Gulch by USFS staff.

- 1,040 willows were planted in Bear Creek. The plantings were concentrated along highly impacted areas of the stream, where the decommissioned Trail #667 crossed Bear Creek. In some areas, sediment was actively entering the stream and impacting fish habitat. RMFI staff and volunteers planted the willows.

- Lastly, 1,135 willows were planted in Severy Creek Wetland on Pikes Peak, a RMFI legacy project. RMFI staff and volunteers planted the willows.

*Task 4 – **COMPLETE** (May 15, 2018 – August 31, 2019)*: **Monitor planting location(s) to determine success of revegetation efforts.**

While this task is complete according to the requirements and timeline of this grant, RMFI will continue to monitor planting locations utilizing the replicable monitoring protocol developed in 2016 to determine success of revegetation efforts. Monitoring is conducted by RMFI staff and USFS personnel. The following observations were made in spring and summer of 2019 by USFS and RMFI personnel at each of the five 2018 planting locations, as well as the two sites in the Waldo Canyon Fire Burn Scar that were planted in 2016 and 2017 (Camp Creek and Waldo Canyon). Observations were recorded on willow monitoring forms (Appendix A, page 11).

Halfmoon Creek (600 willows, 70% survival rate)

Planted: June 6, 2018
Monitored: June 4, 2019

The estimated survival rate at Halfmoon Creek is 70% (Figure 3, page 8). The 600 willows were planted along Halfmoon Creek where recreation sites had encroached stream banks and badly impaired existing vegetation. These sites were first decommissioned by the Leadville Ranger District staff before planting willows. Decommissioning techniques included de-compacting soil, fencing, boulder placement, and signing.

The willows were not expanding and producing additional limbs and leaves at the time of the monitoring visit, likely due to the late and heavy snowpack, however ample buds were observed. Roots appeared to

be anchored and expanding and surface water was observed at each site. There was no evidence of grazing. There were six planting sites within this one location, and one of the sites was believed to have been disturbed. This site had an estimated mortality rate of close to 50% and is believed to be due to human activity. The planting area is good habitat for willows, but the proximity to a high use camping area is believed to be the reason for high mortality. USFS personnel believe campers pulled the willows.

Poncha Creek (1,015 willows, ~70% survival rate)

Planted: June 9, 2018
Monitored: May 17, 2019

The estimated survival rate at Poncha Creek is 70% (Figure 4, page 8). The 1,015 willows were planted in several locations along Poncha Creek. These sites were similarly disturbed to those of Halfmoon. Forest Service engineers and Salida Ranger District staff decommissioned the sites before planting willows.

The willows were observed to be expanding and producing additional limbs and leaves. The roots were anchored and expanding, though a few did not take hold likely due to the deviating level of the water table. There was no evidence of grazing and surface water was observed at each site. A dispersed campsite may be causing streambank instability. Some willows may have washed away during large storm events, and boulders that were emplaced to protect the willows had been displaced.

Molly Gulch (360 willows, ~85% survival rate)

Planted: June 17, 2018
Monitored: May 17, 2019

The estimated survival rate at Molly Gulch is 85%. The 360 willows were planted in Molly Gulch. The water table was much lower than normal, however the perennial stream was still flowing and had not gone subsurface. Subsurface flows may occur during the dry summer months, potentially decreasing survival rates.

The willows were expanding and producing additional limbs and leaves. The roots appeared to be anchored and expanding and surface water was observed at each site. There was evidence of grazing at two of the three planting sites at this location. There was evidence of dispersed camping close to the streambank that was causing instability. The first planting site had an estimated mortality rate of less than 5%, the second site had a mortality rate of 20-30% (due to nearby campsite) and the third site had an estimated mortality rate of less than 10%.

Bear Creek (1,040 willows, ~90% survival rate)

Planted: June 8, 2018
Monitored: June 6, 2019

The estimated survival rate at Bear Creek is 90% (Figure 5, page 9). The 1,040 willows were planted at 7 sites within a 4-mile stretch of Bear Creek. The stream is habitat to the Bear Creek greenback cutthroat trout, Colorado's state fish. RMFI has worked with the USFS and other land management partners to improve the Bear Creek Watershed.

The willows were expanding and producing additional limbs and leaves, however due to the late winter the foliage was limited. The observed mortality is believed to have occurred during a late-season snowstorm that produced heavy snow. A small percentage of willows had broken stems where the plant

grows from the ground. In addition, some willows appeared to have been trampled by illegal hikers (the decommissioned trail is closed to recreation) and/or restoration crews.

Severy Creek Wetland (1,135 willows, survival rate N/A)

Planted: August 1, 2018
Monitored: August 19, 2019

It is too soon to estimate the survival rate of the willows planted in Severy Creek Wetland (Figure 6, page 9). The 1,135 willows were planted in 2018 at an elevation of 10,970 feet. Severy is the location of 15 years of restoration completed by RMFI. The alpine fen was heavily impacted from sedimentation originating from the Pikes Peak Highway.

The willows were observed to have little new growth at the August monitoring visit. There appeared to be evidence of grazing, and the area is known habitat for elk and bighorn sheep. Approximately 50% of the willows had no additional limbs and leaves. The plants will likely produce new growth next season, however there is a high probability of browsing. There is great natural regeneration of willows in the area, however RMFI wanted to plant willows at this site to gage their success as compared to willow stakes planted in 2015. Those stakes do not show signs of new growth but it is not believed to be due to browsing. RMFI will continue to monitor this location.

Camp Creek (1,850 willows, ~75% survival rate)
Planted: May 2016 and August 2017
Visited: June 10, 2019

This is the location of the pilot willow planting in 2016, when 1,000 willows were planted. RMFI planted an additional 850 willows at this location in 2017. The survival rate is estimated to be 75%. There was evidence of browsing, particularly at the planting sites located around the detention ponds that hold water. There was evidence of new growth, however it was limited due to the late winter. The willows have aided in stabilizing this drainage which was severely burned during the Waldo Canyon Fire in 2012. The success of this site and Lower Waldo Canyon has led to the expansion of the program to other disturbed riparian areas.

Waldo Canyon (2,000 willows, ~73% survival rate)

Planted: May 31, 2017
Monitored: June 11, 2019

This Waldo Canyon site was visited more than two years after planting. At the time of planting, the drainage was divided into 11 sections over approximately 1,321 ft. to facilitate future monitoring efforts measuring willow survivability. During the June site visit, approximately 1,458 willows were counted, a survival rate of approximately 73%. Storm events in 2017 are believed to have uprooted many willows, and a drought in 2018 caused additional mortality. There was no new mortality observed in the 2019 monitoring visit. Natural recruitment was observed at many of the sites.

*Task 5 - **COMPLETE**: (May 31 - November 15, 2018)*: **Implement streambank stabilization and erosion control treatments in the Bear Creek Watershed including native species reseeding, cross veins, crib walls, and others.**

RMFI has been completing trail and restoration work in the Bear Creek Watershed since 2009. RMFI's initial work in the watershed focused on short-term, immediate projects to reduce the amount of sediment

transported from the trail to Bear Creek. Solutions included two short trail re-alignments to create a larger vegetation buffer between the trail and creek, constructing sediment traps off the trail to collect sediment, and constructing rock drains to allow water seeps to cross the trail without collecting sediment from the trail. RMFI has also completed new trail construction (to provide recreational access to the watershed on new trails located away from Bear Creek) and closure, decommissioning, and restoration of former trails paralleling Bear Creek. This work has involved the implementation of drainage enhancement, stabilization, and erosion control structures designed to mitigate continued sedimentation into Bear Creek.

RMFI completed 16 days of work in the Watershed with a Mile High Youth Corps crew in 2018. Work focused on the riparian restoration efforts to stabilize slopes located between old trail segments and Bear Creek.

The Mile High Youth Corps decommissioning trails in the Bear Creek Watershed.

*Task 6 – **COMPLETE:** (December 1, 2018 – August 31, 2019)*: **Develop interim reports and a final report detailing project outcomes and results.**

RMFI has completed its commitments of the CWCB grant, however the organization will continue to monitor the willows for the next two years. At that time, the program will be reassessed to determine whether monitor needs to continue. RMFI reported on the status of the willow project in 2018 to the Pikes Peak Environmental Forum, at a 2018 guided tour to Severy Creek on Pikes Peak, at the summer 2019 Bear Creek Roundtable meeting, and the 2019 meeting of the El Paso County Regional Resiliency Collaborative. Results will continue to be shared with the broader community.

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Photo Documentation

Figure 3: Halfmoon Creek. Estimated 70% survival rate. Late snowpack affected new growth.

Figure 4: Poncha Creek. Estimated 30% mortality from eroded streambanks due to recreational impacts.

Figure 5: Bear Creek. Estimated 90% survival rate. Evidence of new growth and browsing.

Figure 6: Severy Creek. Survival rate not available. Slow regrowth and evidence of browsing.

Figure 7: Camp Creek. Estimated 75% survival rate 3 years after planting.

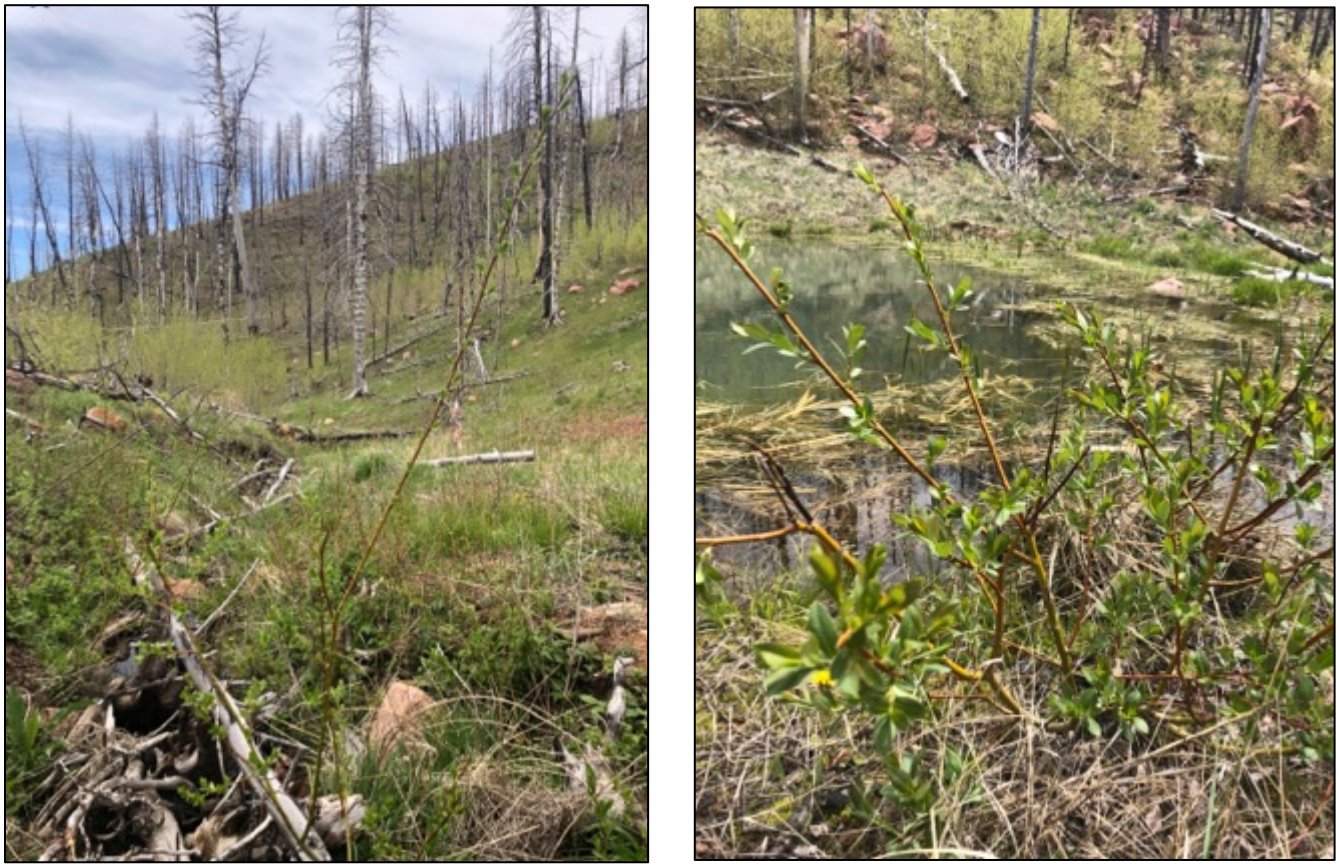

Figure 8: Waldo Canyon. Estimated 73% survival rate 2 years after planting.

Appendix A. Willow Monitoring Forms

100 high altitude willows planted 6-6-2018 Halfmoon 1 Janelle Valladares 6-4-19

OTHER OBSERVATIONS/NOTES

1. Are willows expanding and producing additional limbs and leaves?
   Due to high + late snowpack willows are not leafing out yet but have ample buds
2. If not, do the roots appear the be anchored and expanding?
   Yes
3. Is surface water observed at each site?
   Yes
4. Is there evidence of grazing?
   No
5. Is there evidence of other disturbances (i.e. mass movement, erosion, or tampering)?
   Campsite directly next to planting area.
6. What is the estimated survival/mortality rate?
   50%
7. Other remarks...
   I visited the site ~ 1 month after planting. About 50% of willows had disappeared from the site. Planting area is good/wet habitat for willows. This is a high use camping area. I suspect they were pulled by campers.4

150 High altitude willows planted 6-6-2018 Halfmoon 2

OTHER OBSERVATIONS/NOTES

1. Are willows expanding and producing additional limbs and leaves?
2. If not, do the roots appear the be anchored and expanding?
3. Is surface water observed at each site?
4. Is there evidence of grazing?
5. Is there evidence of other disturbances (i.e. mass movement, erosion, or tampering)?
6. What is the estimated survival/mortality rate?
7. Other remarks...
   Site still mostly under snow. Visible willows are well rooted and have buds

4

150 High altitude willows planted 6.6.2018 Halfmoon 2

OTHER OBSERVATIONS/NOTES

1. Are willows expanding and producing additional limbs and leaves?

2. If not, do the roots appear the be anchored and expanding?

3. Is surface water observed at each site?

4. Is there evidence of grazing?

5. Is there evidence of other disturbances (i.e. mass movement, erosion, or tampering)?

6. What is the estimated survival/mortality rate?

7. Other remarks...
Site still mostly under snow. Visible willows are well rooted and have buds

4

200 High Altitude willows planted 6-6-2018 Halfmoon 3

OTHER OBSERVATIONS/NOTES

1. Are willows expanding and producing additional limbs and leaves?
Due to high late snow pack willows are not leafing out yet but have ample buds

2. If not, do the roots appear the be anchored and expanding?
Yes

3. Is surface water observed at each site?
Ye

4. Is there evidence of grazing?
No

5. Is there evidence of other disturbances (i.e. mass movement, erosion, or tampering)?
Right next to heavily used campsite

6. What is the estimated survival/mortality rate?
80%

7. Other remarks...
These willows look AWESOME! They are tall and well rooted.

4

50 willows planted 6-6-18
high altitude

Halfmoon 4

OTHER OBSERVATIONS/NOTES

1. Are willows expanding and producing additional limbs and leaves?
   Willows are not leafing out yet due to late + heavy snow pack but have ample buds
2. If not, do the roots appear the be anchored and expanding?
   Yes
3. Is surface water observed at each site?
   Yes
4. Is there evidence of grazing?
   No
5. Is there evidence of other disturbances (i.e. mass movement, erosion, or tampering)?
   No
6. What is the estimated survival/mortality rate?
   75%
7. Other remarks...
   Some willows are completely submerged but are still rooted.

4

25 willows planted 6-6-18
high altitude

Halfmoon 5

OTHER OBSERVATIONS/NOTES

1. Are willows expanding and producing additional limbs and leaves?
   willows are not leafing out yet due to late + heavy snow pack but have ample buds
2. If not, do the roots appear the be anchored and expanding?
   Yes
3. Is surface water observed at each site?
   Yes
4. Is there evidence of grazing?
   No
5. Is there evidence of other disturbances (i.e. mass movement, erosion, or tampering)?
   No
6. What is the estimated survival/mortality rate?
   80%
7. Other remarks...
   looking good!

4

75 willows planted 6-6-19
↑ high altitude

Halfmoon 6

OTHER OBSERVATIONS/NOTES

1. Are willows expanding and producing additional limbs and leaves?
2. If not, do the roots appear the be anchored and expanding?
3. Is surface water observed at each site?
4. Is there evidence of grazing?
5. Is there evidence of other disturbances (i.e. mass movement, erosion, or tampering)?
6. What is the estimated survival/mortality rate?
7. Other remarks...

Site still mostly under snow. Visible willows are well rooted + have buds

4

Silver Creek
U.S Reach

OTHER OBSERVATION/NOTES

Silver Cr D.S. reach
Salt Isabel, NE

5/17/2019
Leah Shipkey

1. Are willows expanding and producing additional limbs or leaves?
#3 yes | budding
#2 Check twigs may be getting really long
#1 yes
2. If not, do the roots appear to be anchored and expanding?
#3 yes
3. Is surface water observed at each site?
#3 yes 2 and about dry
4. Is there evidence of grazing?
#3 no
#2 yes
#1 yes
5. Is there evidence of other disturbances (i.e. erosion, tampering, or insects)?
#3 dispersed camp 2 several beaver impacts

grazing
Beaver

6. What is the estimated mortality rate?
#3 <10% mortality
#2 20-30%
#1 <5%

Higher mortality rate
not sure why

7. Other remarks...
#3 most rec. use
#2 middle amount of rec. most willow planted
#1 least amount of rec

5/17/2019
Leah Shipstead

OTHER OBSERVATION/NOTES

Porcha CK, San Isabel NF

1. Are willows expanding and producing additional limbs or leaves?

   yes & budding

2. If not, do the roots appear to be anchored and expanding?

   yes but a few (5) did not take hold (likely bc of deviating water table)

3. Is surface water observed at each site?

   yes, @ and above bankful

4. Is there evidence of grazing?

   no

5. Is there evidence of other disturbances (i.e. erosion, tampering, or insects)?

   (Approx to 150-200)

   disperse campsite causing streambank instability, Boulder in creek and maybe some stream morphology changes

6. What is the estimated mortality rate?

   30ish percent

7. Other remarks...

   water is @ bankful or a little above, some could have washed away willows were planted below bankful

   dispersed site was supposed to stay closed but, boulders were moved.

   Porcha

June 6th, 2019

WILLOW MONITORING FIELD DATA SHEET

Date: Planting Location: Bear Creek Name of Observers: Joe Lavorini, Leah Shipstead

Temperature (°F): 73° F Elevation (ft.): ~9,500 ft Average Monthly Precipitation (~~in.~~ cm): 5.9 cm

A Zone #	B # Willows Planted	C # Surviving Willows	D # Mortality Observed	E % Estimated Survival Rate (C/B)*100	F Willow Species Observed	G Observations/Notes
1	50			5% or less	Bebb & Exigia	
2	50			~~5% or less~~	Bebb & Exigia	some evidence of budding/flowers
3	50			5% or less	Bebb & Exigia	
4	50			5% or less	Bebb & Exigia	broken at bottom from snow
5	50			5% or less	Bebb & Exigia	broken at bottom from snow?
6	100			10% or less	Bebb & Exigia	[illegible] observed [illegible] of trampling
7	150			5% or less	Bebb & Exigia	budding, roots expanding, minimal [illegible] did [illegible] willow
8	150			10-15% mortality	Bebb & Exigia	Dam/bridge causing silting [illegible] we took it out. No sign of [illegible]
9	175			10% or less	Bebb & Exigia	
10	175			10% or less	Bebb & Exigia	
11					Bebb & Exigia	

1

SEVERY CREEK WETLAND - 1,250 willows TOTAL

Aug 19, 2019

WILLOW MONITORING FIELD DATA SHEET

Date: Planting Location: Name of Observers: Joe Lavorini

Temperature (°F): 80°-90° Elevation (ft.): 1°, 500' Average Monthly Precipitation (in): 3.9 cm

A Zone #	B # Willows Planted	C # Surviving Willows	D # Mortality Observed	E % Estimated Survival Rate (C/B)*100	F Willow Species Observed	G Observations/Notes
1				50% *	Bebb & Exigia	Heavy browsing
2					Bebb & Exigia	Rocky Mountain willow? Salix wentirola Bebb?
3					Bebb & Exigia	
4					Bebb & Exigia	
5					Bebb & Exigia	
6					Bebb & Exigia	
7					Bebb & Exigia	
8					Bebb & Exigia	
9					Bebb & Exigia	
10					Bebb & Exigia	
11					Bebb & Exigia	

* ~50% of willows had no foliage. The top of ~95% of willows appeared to have been chewed off. Will likely produce shoots next season, will they be browsed again?

* Check planting photos - what do the tops look like?

OTHER OBSERVATIONS/NOTES

1. Are willows expanding and producing additional limbs and leaves?
   NO. There is some new growth where the plant stem/trunk meets the soil.
2. If not, do the roots appear the be anchored and expanding?
   Roots appear to be anchored into soil. Can't tell if they are expanding.
3. Is surface water observed at each site?
   YES. Willows are clearly in water table.
4. Is there evidence of grazing?
   YES. I believe grazing is the cause of lack of foliage.
   No fresh sign of grazing (some older scat, no tracks, no new scat)
5. Is there evidence of other disturbances (i.e. mass movement, erosion, or tampering)?
   NO.
6. What is the estimated survival/mortality rate?
   Too soon to know. Approximately 50% of willows have no foliage. The 50% w/ foliage is sparse - small shoots 4-5" in length - at most.
7. Other remarks...
   It looks like willows were browsed heavily after planting, stripping the plants of their leaves. Some growth is occurring - mostly new shoots starting from ground new level.

Any new growth is sparse + originating from ground level.

The willow stakes we planted in 2025 are still not producing much foliage. The transplanted bunch grasses in surrounding area are doing great. This implies willow stakes are in the water table. So why little foliage? Browsing? Natural regrowth of willows is abundant.

* Look on back

WILLOW MONITORING FIELD DATA SHEET

June 30th, 2019 Camp Creek
Date: Planting Location: Name of Observers: Joe Lavorini, Josh, Leah, Jay

Temperature (°F): 85°F Elevation (ft.): 9,000' Average Monthly Precipitation (in.): 5.9 cm

A Zone #	B # Willows Planted	C # Surviving Willows	D # Mortality Observed	E % Estimated Survival Rate (C/B)*100	F Willow Species Observed	G Observations/Notes
1	25	20		80	Bebb & Exigia	
2	125	120		96	Bebb & Exigia	
3	100	70		70	Bebb & Exigia	
4	50	40		80	Bebb & Exigia	
5	100	65		65	Bebb & Exigia	mortality higher for upland/bob
6	100	85		85	Bebb & Exigia	
7	75	65		86	Bebb & Exigia	
8	75	65		86	Bebb & Exigia	
9	150	125		83	Bebb & Exigia	
10	100	75		75	Bebb & Exigia	
11					Bebb & Exigia	

1

June 11, 2019

WILLOW MONITORING FIELD DATA SHEET

Date: ~~May 18, 2018~~ Planting Location: Waldo Canyon Name of Observers: ~~Hannah Millsap, Joe Lavorini~~ Leah Shipstead, Josh Vorlon

Temperature (°F): _____ Elevation (ft.): _____ Average Monthly Precipitation (in.): _____

A Zone #	B # Willows Planted	C # Surviving Willows	D # Mortality Observed	E % Estimated Survival Rate (C/B)*100	F Willow Species Observed	G Observations/Notes
1	175	150	0		Bebb & Exigia	WC Wetland
2	200	200	0		Bebb & Exigia	wetland
3	100	80	0		Bebb & Exigia	
4	100	20	0		Bebb & Exigia	
5	200	150-175	0		Bebb & Exigia	
6	50	35	0		Bebb & Exigia	
7	100	75	0		Bebb & Exigia	
8	213	213	0		Bebb & Exigia	
9	75	60	0		Bebb & Exigia	Natural Recruitment
10	525	250	0		Bebb & Exigia	
11	262	150	0		Bebb & Exigia	

After 2017 storms some willows missing downstream. 203 drought conditions caused some mortality. No mortality observed in 2019 monitoring. Sites 9, 10, Nat. Recruitment observed at sites 9 and downstream